REMEDIAL ACTION PLAN
SCDHS-EHD SITE # 00001063
SANTA ROSA, CALIFORNIA

July 28, 2005

A Report Prepared for:

Mr. A.K. Jain
Department of General Services
RESD/PSB/Seismic & Special Programs
707 3rd Street, Suite 4-430
West Sacramento, CA 95605

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SANTA ROSA, CALIFORNIA
Kleinfelder Job No. 58281

Prepared by:

Tim Crandall, PE
Senior Engineer

Dave Auble
Project Engineer

Reviewed by:

David V. Jenkins, PE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
DAVID V.
JENKINS
C59514
Exp 12/31/05
CIVIL
STATE OF CALIFORNIA

Pamela A. Wee, D. Env.
Project Manager

KLEINFELDER, INC.
3077 Fite Circle
Sacramento, California 95827
(916) 366-1701

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1 INTRODUCTION

1.1. SITE DESCRIPTION

The site was formerly used as a California Highway Patrol (CHP) facility located at 3854 Santa Rosa Avenue, in Santa Rosa, California. The site is currently leased by Enterprise Rent-A-Car, with the former CHP building being used as the office. The building is single story measuring approximately 95 by 70 feet. The surface surrounding the building consists of asphalt and concrete. Rental cars are parked throughout the site, including the proposed remedial treatment area. Plate 1 shows the site and surrounding features.

1.2. SITE HISTORY

A 12,000-gallon unleaded gasoline underground storage tank (UST) and associated equipment were removed from the site on December 3, 1991. The UST was located north of the building. Two confirmation soil samples were collected from the excavation. Based on petroleum hydrocarbons detected in one of the soil samples, Sonoma County Department of Health requested additional investigation of soil and groundwater impact at the site. To date, 10 borings have been advanced at the site. Seven of the 10 borings were converted to groundwater monitoring wells MW-1 through MW-7. Three of the seven wells were installed in 1992. The remaining four wells were installed in 1994.

1.3. GEOLOGY AND HYDROGEOLOGY

Regional

The site is located in the central area of the Santa Rosa Plain in the Coast Range Province. Surface water from the Santa Rosa Plain drains to the northwest toward the Russian River and then to the Pacific Ocean. The broad gentle plain on which the site is located is topographically known as the Cotati Valley. A Quaternary sequence of alluvium deposits, are described as Pleistocene and Quarternary alluvial fans, and Pliocene-Pleistocene fluvial-lacustrine (lake) deposits.

Surrounding and underlying the Santa Rosa Plain, bedrock in the area consists of the Mesozoic Franciscan Complex. This complex consists of strongly deformed, weakly metamorphosed marine sedimentary rocks with blocks and slabs of volcanic oceanic crust tectonically mixed within the sedimentary materials. Overlying the bedrock is a thick sequence of volcanic and volcano-clastic rocks of late Tertiary age (late Miocene and Pliocene). Interbedded and interfingered with the volcanic rocks are non-marine, transitional marine, and marine sedimentary. The area is highly structurally complex with numerous faults, both active and inactive, that cut through the geologic units.

Local

At the site, clay and gravel (fill) are present from below the asphalt and concrete surface to approximately 4 feet below ground surface (bgs). Unconsolidated silty sand is present below the fill. Clay and silt interbeds are present in the silty sand. Clay is present below the silty sand. During the installation of the monitoring wells, groundwater was encountered between 10 and 15 feet bgs. Static water levels range from 5 to 11 feet bgs. Groundwater gradient direction has varied from south-southwest to south-southeast.

1.4. NATURE AND EXTENT OF CONTAMINATION

1.4.1. Soil

During the UST removal, two confirmation soil samples were collected from the excavation at 13.5 feet bgs from the west end and at 14 feet bgs from the east end. The samples were analyzed for total petroleum hydrocarbons (TPH) as gasoline, benzene, toluene, ethylbenzene, and total xylenes. Total xylenes were detected at 0.007 milligrams per kilogram (mg/kg) or parts per million (ppm) in the west end sample. The remaining constituents were not detected above laboratory reporting limits. Of the 10 borings advanced at the site, petroleum hydrocarbons were detected above laboratory reporting limits in soil samples from only one boring (MW-2). TPH gasoline was detected at 24 and 74 mg/kg in the two soil samples collected from 10 and 15 feet bgs from MW-2. MW-2 is located approximately 20 feet downgradient (southwest) of the former UST, and approximately 7 feet from a formerly located remote fill port for the UST. Therefore, the location of the petroleum hydrocarbon mass remaining at the site has been estimated as follows:

Lateral Extent

- Approximately halfway between MW-2 and MW-5 and to the UST excavation (24 feet).
- Approximately halfway between MW-2 and soil boring SB-1 (12 feet).

Vertical Extent

- Approximately 10 to 15 feet bgs.

1.4.2. Groundwater

Seven groundwater monitoring wells (MW-1 through MW-7) have been installed at the site. Wells MW-1 through MW-3 were installed in 1992. The remaining four wells (MW-4 through MW-7) were installed in 1994. Between April 1997 and February 2001, groundwater monitoring was not conducted. The last monitoring event was performed in April 2001.

TPH as gasoline, benzene, toluene, ethylbenzene, total xylenes, and fuel oxygenates have been detected in the groundwater at the site. The highest concentrations of TPH gasoline have been detected in MW-2, approximately 20 feet southwest (downgradient) of the former UST. The highest concentration of TPH gasoline in MW-2 was detected in September 1992 at 70,000 micrograms per liter (ug/L) or parts per billion (ppb). TPH gasoline concentrations in MW-2 have steadily decreased to 3,100 ug/L during the April 2001 monitoring event.

Beginning in March 2000, the fuel oxygenates were added to the analyses list. MTBE has been detected in wells MW-1, MW-3, and MW-4. The highest concentrations of MTBE have been detected in MW-3, located adjacent and southwest (downgradient) of the former UST and pump island. The highest concentration of MTBE in MW-3 was detected in October 2000 at 47 ug/L. MTBE concentrations in MW-3 have steadily decreased to 5.6 ug/L during the April 2001 monitoring event.

Static water levels range from 5 to 11 feet bgs. Groundwater gradient direction has varied from south-southwest to south-southeast.

In the July 9, 2003 feasibility study prepared by MACTEC, the in place volume of affected groundwater was estimated to be approximately 13,500 cubic feet. The total (dissolved plus sorbed) mass of contaminant (TPH-g) in that volume of water was estimated to be approximately 19 kilograms.

1.5. REMEDIAL OBJECTIVES

1.5.1. Media Selected for Remediation

Groundwater and saturated soil are the selected media for remediation. Only low levels of total xylenes were detected in vadose zone soils and further remediation of soil is not deemed necessary.

1.5.2. Remedial Goals

Remediation goals (maximum contaminant level, MCL) have been established the State of California for the constituents of concern in groundwater. During April 2001 (most recent monitoring event), the following constituents were detected above MCLs:

- TPH gasoline at 3,100 ug/L. Although no MCL has been established, Sonoma County suggested a treatment goal of 50 ug/L.
- Benzene at 4,100 ug/L. Primary MCL is 1 ug/L.
- Toluene at 1,200 ug/L. Primary MCL is 150 ug/L.
- Ethylbenzene at 4,100 ug/L. Primary MCL is 680 ug/L.
- Total Xylenes at 4,100 ug/L. Primary MCL is 1,750 ug/L.
- MTBE at 5.6 ug/L. Primary MCL is 13 ug/L, Secondary MCL is 5 ug/L.

The performance objective of the remediation system is to reduce the groundwater concentration of the constituents listed above to concentrations less than the corresponding action levels.

2 REMEDIATION DESIGN AND EXECUTION

2.1. PROPOSED REMEDIAL SYSTEM

Given the type, extent, and concentration of groundwater impacts as well as the local geology, an ozone sparge system is proposed. Through a network of sparge wells screened in first encountered groundwater, ozone will be pumped into the formation where it will react with the impact constituents, oxidizing them ultimately to carbon dioxide. The system will also be designed with the capacity to inject hydrogen peroxide into the sparge wells, which acts synergistically with the ozone to enhance the oxidative environment.

2.2. SPARGE WELL DESIGN

Based on the extent of contamination four sparge wells are proposed for the site. The layout of the sparge wells is provided on Plate 2. The sparge wells will consist of 3/8" diameter stainless steel tubing with specially designed Spargepoints® developed by KVA (remediation equipment manufacturer) as part of their C-Sparge system placed at a depth of 27 feet below grade. Spargepoints® were selected rather than screened pipe because they generate smaller bubbles (1/100 the size of bubbles generated with 0.010" slotted pipe) that better permeate tight and/or heterogeneous soils and distribute more evenly with less likelihood of groundwater mounding or flow channeling. In addition to the sparge piping, a 1/2-inch HPDE line will be placed in the boring to just above the Spargepoints® and within the sand pack. This piping will be terminated at each well head with double check valves and will allow the optional delivery of hydrogen peroxide to the subsurface to supplement the ozone as necessary. The sparge wellheads will include double SS welded check valves. The borehole for the sparge wells will be advanced with an 8-inch hollow stem auger. An illustration of the sparge well is presented on Plate 3.

A series of 3/8-inch welded stainless steel tubes will connect the remediation system to the ozone sparge wellheads. The stainless steel tubes will be installed in a trench following the alignment shown on Plate 2. The trench will be approximately 2 feet deep and will be backfilled with compacted sand and a controlled density fill, and then topped with matching cover material and thickness.

2.3. REMEDIATION EQUIPMENT

The remediation system will consist of two primary pieces of equipment 1) the ozone generator, and 2) distribution tubing. The ozone sparging will be performed with a 20 gram/hour (1.0 pound/day) ozone generator and reach a flow of 2-3 scfm to each of the sparge points. The ozone generator is a small, self-contained panel that will be mounted on the side of the existing building. The process and instrumentation diagrams for the system are shown on Plate 4.

In addition to the remediation equipment, several pieces of monitoring equipment will be utilized during the remediation system described as follows:

Photometric Ozone Test Kit This testing kit will be used to measure ozone dissolved in groundwater. The test kit is capable of detecting ozone concentrations from 0 to 2 ppm in water.

Photometric Ozone Monitor This instrument will be used to quantitatively measure gaseous ozone at the site, specifically at the monitoring well openings to the atmosphere. The meter can detect ozone as low as 3 ppb, can log readings versus time, and comes with an internal sampling/purging pump.

ORP/DO/pH/Conductivity/Salinity/Temperature Meter This is a submersible multi-parameter instrument designed to monitor oxidation/reduction potential, dissolved oxygen, conductivity, salinity and temperature in groundwater.

Ozone Test Strips Ozone test strips will be used as an inexpensive way to measure gaseous ozone near monitoring wells. Each strip is chemically treated to react with ozone. For the remediation system, strips with a range of 0.075 to 0.105 ppm of ozone will be used.

Personal Ozone Monitor The personal ozone monitor is a simple personal monitoring device for measuring personnel's exposure to ozone at the site. Using specially treated paper the personal ozone monitor provides readings for short-term exposure (one hour), and average long-term exposure (eight hours). Readings range from 10 to 350 ppb.

2.4. REMEDIATION SYSTEM OPERATION

Once the system is installed and operating we expect that the flow rate maintained by the sparge well will be 2-3 scfm. This flow rate is sufficient to provide sufficient exit velocity to drive lateral transport of air, and low enough to mitigate fugitive emissions of ozone to the surface. Ozone and TPH monitoring will be used to check if sparge air has migrated to the surface in detectable amounts. It is expected that the sparge wells will be operated sequentially, and the treatment system will automatically divert ozone from well to well according to a programmed time schedule.

2.4.1. System Startup

2.4.1.1. Baseline Sampling

Prior to starting up the remediation system, baseline conditions will be recorded to establish a reference from which to gauge the effect of the ozone remediation system. To establish groundwater concentrations of contaminants in the area, a groundwater sample will be taken from MW-1 through MW-5 before operation of the system and analyzed for TPH, BTEX and MTBE by EPA Method 8260. Offsite wells MW-6 and 7 will not be sampled due to their history of non-detects and distance from the remediation system. The Kleinfelder standard groundwater monitoring protocol will be observed. In addition, field measurements will be taken in MW-1 through MW-5 for pH, dissolved oxygen, conductivity, oxidation/reduction potential (ORP), and temperature. Changes in these parameters will be used to evaluate the presence and effect of ozone in groundwater in the vicinity of the remediation system well.

2.4.1.2. System Checkout and Preparation

Prior to starting the ozone compressor, all well caps and traffic lids (as applicable) will be removed from MW-1 through MW-5. The well casings will be fitted with air tight caps. Initial system operation will consist of a thorough system checkout followed by a systematic startup. Checkout will consist first of an electrical checkout to ensure proper wiring and power supply to the system. The checkout will continue with operation of the ozone generator independently for a short time and checking carefully for any leaks in the supply line with the ozone monitor. Each equipment item will then be thoroughly checked for proper operation, as evidenced by performance and the lack of excessive vibration or noise or presence of ozone in the air.

2.4.1.3. Remediation Execution

Once appropriate systems checkouts have been performed the remediation system will begin operation. The test will involve performing frequent monitoring and sampling of operation parameters (i.e., concentrations, flows, and pressures) on the first day of operation.

Regular system monitoring during startup will facilitate verification of anticipated sparging flow and pressure at the sparge wells. Dissolved concentrations of several indicators in the monitoring wells will be frequently monitored to provide an initial evaluation of the area of coverage of the ozone sparge system. These data will be used to calculate the sparge well radius of influence and the resiliency of the ozone. Gaseous ozone will be monitored at the outlet of each monitoring well immediately after startup of the system to ensure that excessive ozone is not escaping from the wells (see Section 2.6 for safety considerations). The pH, dissolved oxygen, conductivity, oxidation/reduction potential (ORP), and temperature in each of the monitoring wells will be measured after air sparging has been running for at least an hour.

2.4.2. Monitoring and Sampling Schedule During Operation

During operation, the remediation system will be monitored frequently on the first day of operation and then visited daily for the purposes of monitoring. Monitoring protocol will serve the following objectives:

- estimate the mass of ozone being injected
- estimate location/dynamics of sparging influence
- assess the resiliency and effect of ozone on the nearby groundwater
- evaluate radius of influence of the ozone system
- estimate the flow/pressure dynamics of the sparge well

The following table summarizes the monitoring and sampling program for the remediation system startup and first year of operation.

TABLE 2-1
MONITORING AND SAMPLING PROGRAM

System Component	Parameter	Method	Frequency
Sparge Well	Pressure	Fixed Pressure Gauge	Hourly first day, weekly first month
Monitoring Well MW-1 through MW-5	Total TPH, BTEX, and 1,2-DCA	Analytical Sample, EPA Method 8260	Weekly first month, then monthly
Monitoring Wells MW-1 through MW-5	pH	Portable Meter	Hourly first day, daily first week, weekly first month, then monthly
	DO	Portable Meter	
	Conductivity	Portable Meter	
	Temperature	Portable Meter	
	ORP	Portable Meter	
	Dissolved ozone	Test Kit	
	Gaseous ozone	Ozone Meter	

2.4.3. Scheduled Peroxide Injections

Evaluation of monitoring parameters while operating the remediation system may lead to implementation of scheduled hydrogen peroxide injections. This will be scheduled with a mobile peroxide injection service at an approximate rate of 10 pounds per well per application. Application would be anticipated to occur on a monthly basis.

2.5. MAINTENANCE

All remediation system equipment will be operated and maintained according to manufacturer's specifications. If problems or anomalies with system operations develop during operation that cannot be expeditiously resolved by Kleinfelder personnel, a site visit by the manufacturer may be required for maintenance, troubleshooting and/or repair. At least a 90% system uptime is anticipated assuming uninterrupted electrical power is provided.

2.6. SITE SAFETY

2.6.1. Emergency Shutdown Procedures

Though not anticipated, in the event of an emergency condition, the entire system will be shut down. The shutdown succession will involve switching off the main electrical breaker to the system as soon as it is safe to do so. The emergency shutoff location will be clearly marked at the site. If fire, chemical release, excessive equipment temperature, or electrical malfunction prevent access to shutoff locations, all personnel will leave the site and notify appropriate emergency personnel immediately.

2.6.2. Hazardous Conditions

The remediation system equipment and the performance of the remediation system can present potential hazardous conditions for personnel. The ozone and compressor units, if not properly installed and handled, can produce an electric shock or burn hazard. The possible mobilization of contaminated soil gas can produce breathing hazards. A PID will be used to routinely (at least hourly) monitor the breathing zone in the remediation area while personnel are present. If a measurable concentration is measured on the PID, the system will be inspected for leaks and repaired. If 5 ppm or more is measured in the breathing zone, the system will be shut down and personnel will leave the area until it is safe to diagnose the problem.

The ozone generator also presents potential hazards to personnel. The National Institute for Occupational Safety and Health (NIOSH) indicates a safe breathing limit for ozone of 0.1 ppm and the compound is immediately dangerous to life and health at 10 ppm. To ensure safety, all personnel will be required to wear personal ozone monitors (see Section 2.3) and ozone will be continuously monitored at the site while personnel are present and as personnel are approaching the site. In addition, 0.075 to 0.105 ppm ozone test strips will be permanently placed at all monitoring well heads to check for undesirable levels of ozone gas escaping from nearby wells. If levels above 0.1 ppm are recorded in the breathing zone at the site or in nearby monitoring wells, and a system leak is not detected, the ozone delivery rate and/or flow in the sparge wells will be reduced to remedy the situation.

In addition to gaseous ozone hazards, groundwater in the nearby monitoring wells may contain enough dissolved ozone to irritate or burn the skin if exposed during sampling operations. Nitrile gloves will be worn during any handling or sampling of groundwater within 200 feet of the ozone sparge well, and groundwater will not be sampled until the ORP reads between 1,000 and -1,000 mV.

3 REPORTING

Following construction of the remediation system and startup, Kleinfelder will prepare quarterly reports documenting system operation and monitoring results. The reports will address the following:

- Period of operation.
- Discussion of shut-downs and other operating issues.
- Monthly groundwater and sparge well monitoring results.
- Quarterly groundwater monitoring results.
- Assessment of system performance.

4 LIMITATIONS

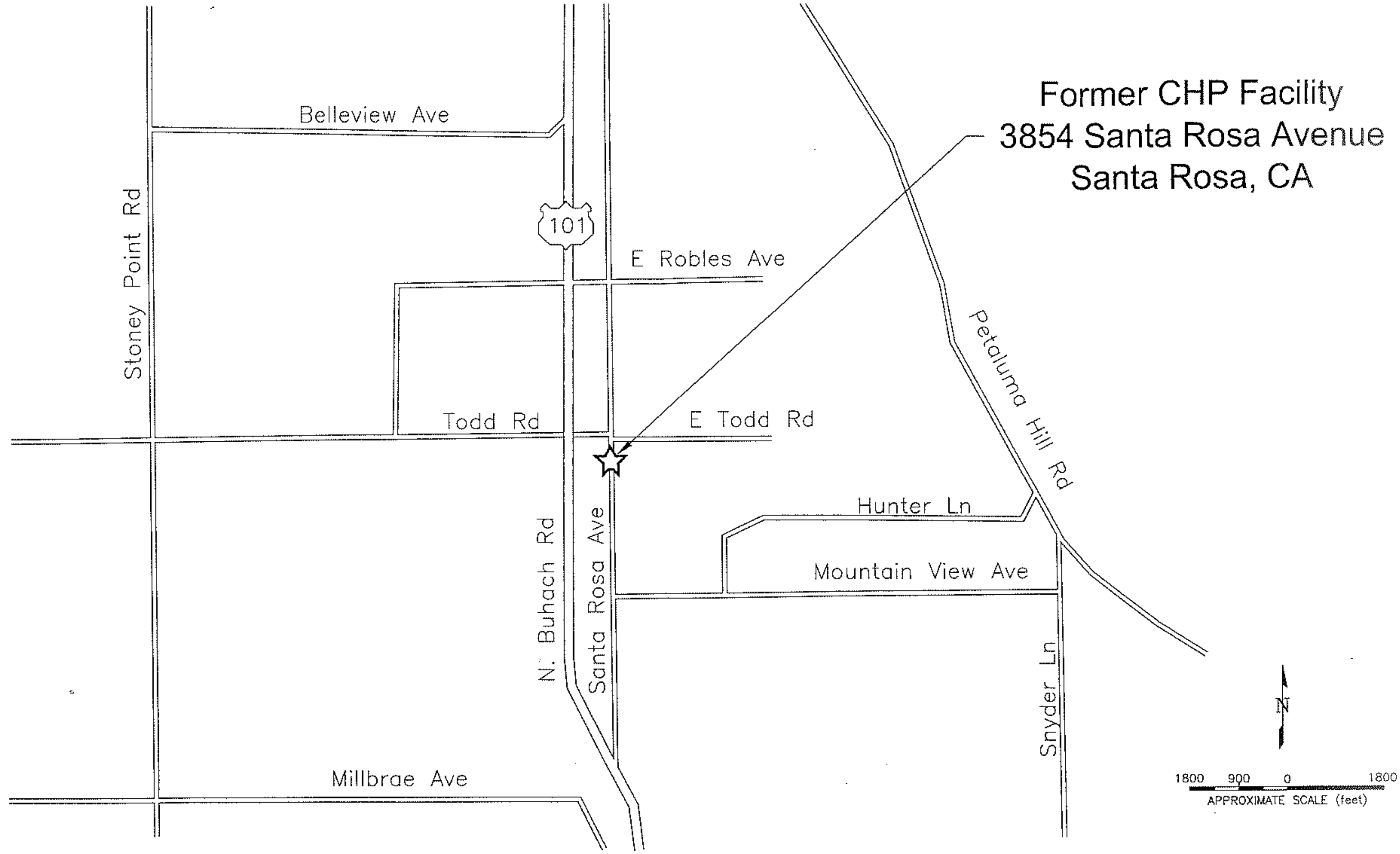
Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive investigations yield more information, which may help understand and manage the level of risk. Since detailed investigation and analysis involves greater expense, our clients participate in determining levels of service which provide adequate information for their purposes at acceptable levels of risk. Acceptance of this work plan will indicate that the client has reviewed the scope of work and determined that the client does not need or want a greater level of service than will be provided. Any exceptions should be noted and may result in higher fees.

Regulations and professional standards applicable to Kleinfelder's services are continually evolving. Techniques are, by necessity, often new and relatively untried. Different professionals may reasonably adopt different approaches to similar problems. Therefore, no warranty or guarantee, expressed or implied, will be included in Kleinfelder's scope of service.

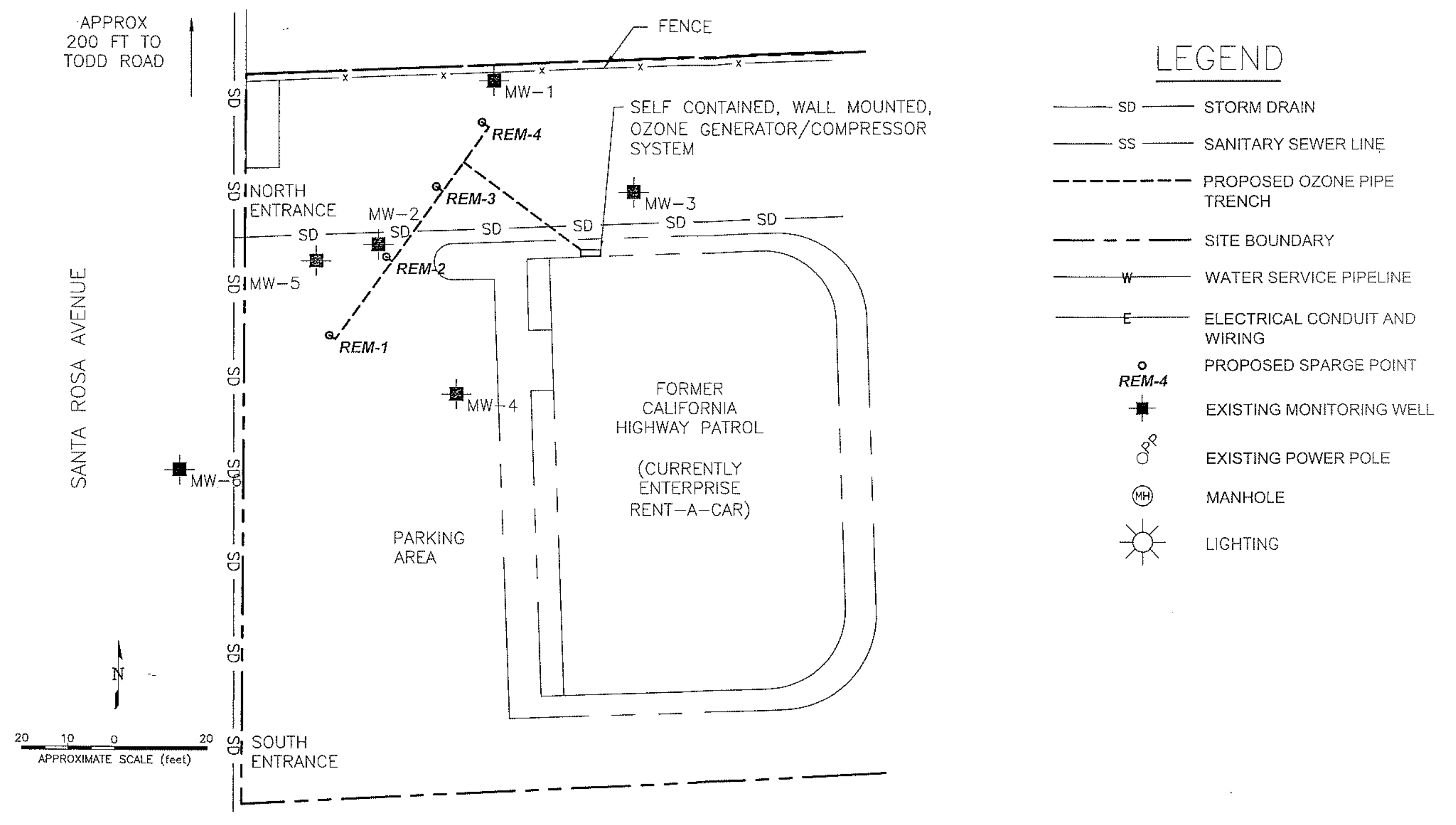
During the course of the performance of Kleinfelder's services, hazardous materials may be discovered. Kleinfelder will assume no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury that results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

Nothing contained in this work plan should be construed or interpreted as requiring Kleinfelder to assume the status of an owner, operator, generator, or person who arranges for disposal, transport, storage or treatment of hazardous materials within the meaning of any governmental statute, regulation or order. The client will be solely responsible for notifying all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials observed at the project site, either before or during performance of Kleinfelder's services. The client will be responsible for all arrangements to lawfully store, treat, recycle, dispose, or otherwise handle hazardous materials, including cuttings and samples resulting from Kleinfelder's services.

This work plan may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time.



KLEINFELDER		SITE VICINITY MAP FORMER CHP FACILITY 3854 SANTA ROSA AVENUE SANTA ROSA, CA	PLATE 1
Drawn By: DCA Project No.: 58281	Date: 07-21-05 Filename: C01R0		



SCOURCE: MACTEC−TPH GASOLINE CONCENTRATIONS IN GROUNDWATER, FORMER CHP FACILITY 06/03

KLEINFELDER

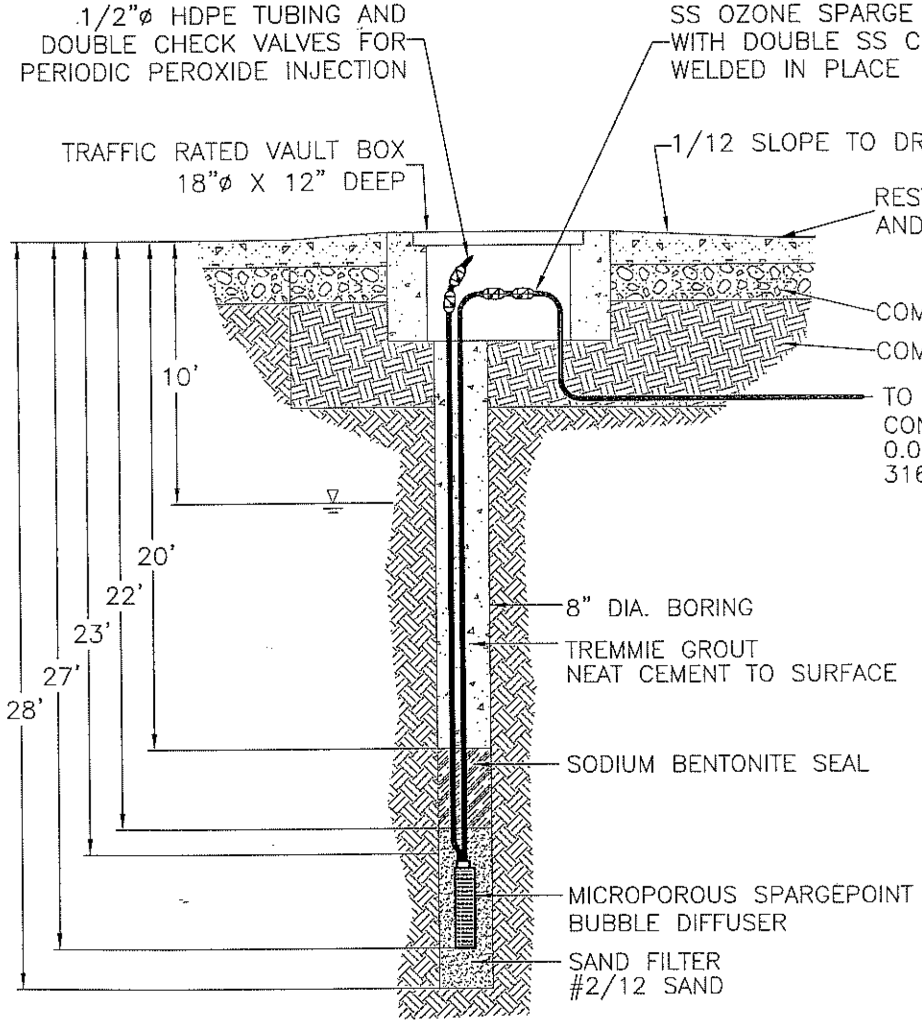
Drawn By: DCA
Project No.: 58281

Date: 07−27−05
Filename: C02R0

SITE PLAN AND LAYOUT

FORMER CHP FACILITY
3854 SANTA ROSA AVENUE
SANTA ROSA, CALIFORNIA

PLATE
2

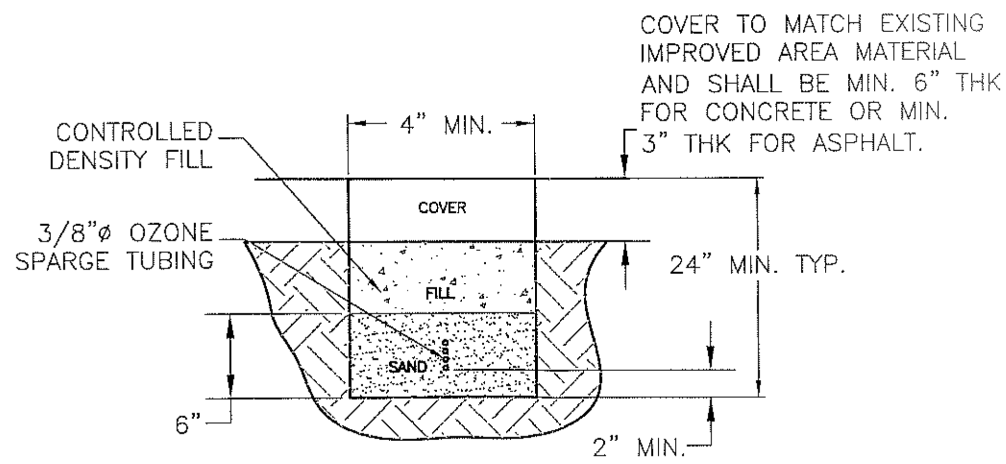


OZONE SPARGING/PEROXIDE INJECTION WELL DESIGN DETAIL

NOT TO SCALE

1. ALL OZONE SPARGE TUBING SHALL BE IDENTIFIED AND LABELED "OZONE GAS-HIGHLY TOXIC OXIDIZER" AND SHALL BE CONSTRUCTED OF CONTINUOUS SS TUBING AND WELDED FITTINGS BETWEEN SPARGEPOINT AND OZONE GENERATOR CABINET.

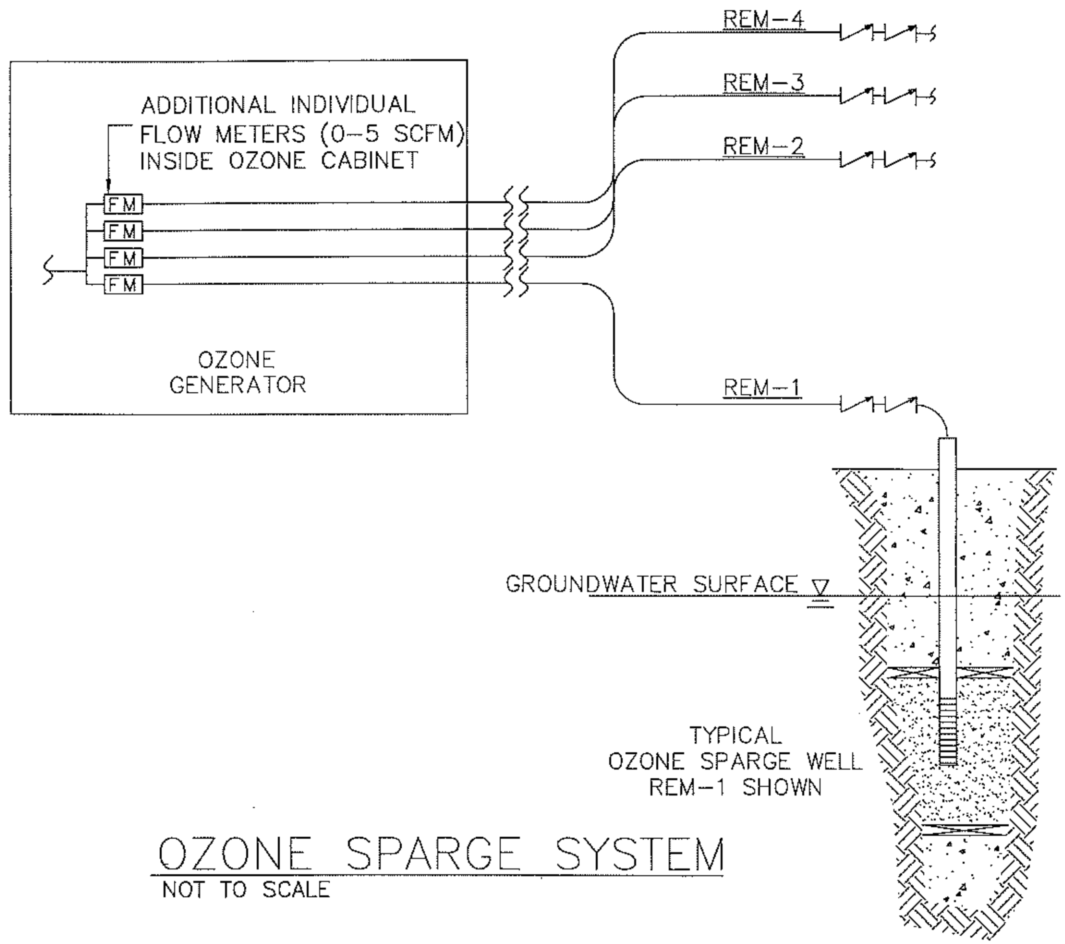
2. ALL TUBING SLOT TRENCH FILL SHALL BE COMPACTED SAND OVERLAIN BY A CONTROLLED DENSITY FILL, AND THEN THE SURFACE PAVEMENT (EITHER ASPHALT OR CONCRETE). FIRMLY TAMP SAND AROUND TUBING TAKING CARE NOT TO DAMAGE TUBING.



TYPICAL TRENCH CROSS SECTION

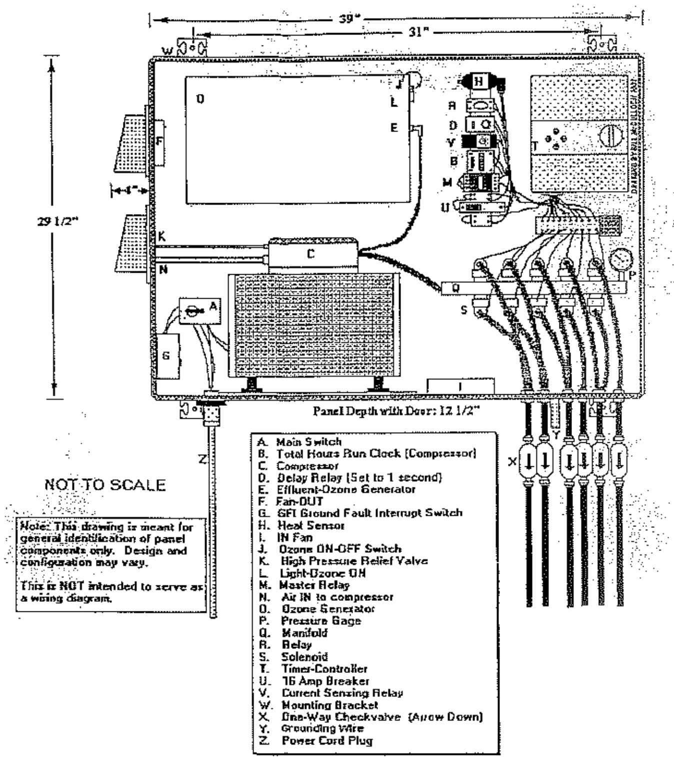
NOT TO SCALE

KLEINFELDER		OZONE SPARGING REMEDIATION WELL ILLUSTRATION FORMER CHP FACILITY 3854 SANTA ROSA AVENUE SANTA ROSA, CA	PLATE 3
Drawn By: DCA Project No.: 58281	Date: 07-27-05 Filename: C03R0		



OZONE SPARGE SYSTEM

NOT TO SCALE



OZONE GENERATOR

NOT TO SCALE

EQUIPMENT	PROVIDER		INSTALLER	
	KLEINFELDER	CONTRACTOR	KLEINFELDER	CONTRACTOR
AIR/OZONE SPARGE SYSTEM	X		X	
EQUIPMENT/MATERIALS FOR WELLS	X		X	
HOOKUP OF ELECTRICAL SERVICE	X		X	
HOOKUP OF EQUIPMENT TO PIPING		X		X
SIGNS, SECURITY & LIGHTING		X		X
TRAFFIC BOXES FOR WELLHEADS	X		X	
VALVES		X		X
CONVEYANCE LINES		X		X
AUTODIALER FOR SYSTEM		X		X
FIRE EXTINGUISHERS		X		X
MISCELLANEOUS HARDWARE		X		X
BACKFILL/TRENCHING		X		X
ROAD SURFACE REPAIR		X	N/A	N/A
PERMITS (ENCROACHMENT, OTHER)		X	N/A	N/A
PERMITS (BLDG DEPT, AIR)	X		N/A	N/A

KLEINFELDER

Drawn By: DCA
Project No.: 58281
Date: 07–27–05
Filename: C04R0

PROCESS FLOW DIAGRAM-
OZONE SPARGE SYSTEM
FORMER CHP FACILITY
3854 SANTA ROSA AVENUE
SANTA ROSA, CA

PLATE
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